

LADWP's Comments on Volume 3 of the California Water Plan Update 2013

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Attachments: CA Water Plan Update 2013~1.xlsx (14 KB) ; Vol3_Ch15_DrinkingWaterTre~1.pdf (283 KB) ; Vol3_Ch30_WaterAndCulture_~1.pdf (219 KB)

Mr. Paul Massera,

The Los Angeles Department of Water and Power (LADWP) has completed its review of Volume 3 Chapters 15 and 30 of the California Water Plan Update 2013. Attached to this email is a summary of comments and annotated PDF documents as recommended in the Reviewer's Guide.

LADWP would like to thank you for this opportunity to provide our input. Please feel free to contact my staff, Simon Hsu, at (213) 367-2970 if you have any questions or concerns regarding our comments to the California Plan Update 2013.

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LADWP's CA Water Plan Update 2013 Volume 3 Comments

11/21/2013

Comment #	Section	Page #	Line #	Comment
1	Ch 15 - Drinking Water Treatment and Distribution	18	39	Change "25 years ago" to "40 years ago"
2	Ch 15 - Drinking Water Treatment and Distribution	18	40	Replace "2008" with "2010 UWMP Exhibit 3A"
3	Ch 30 - Water and Culture	6	38	Suggest Removing sensitive statement: " LADWP diversions have dried Owens Lake and reduced Mono Lake water levels ".

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Chapter 15. Drinking Water Treatment and Distribution

Providing a reliable supply of safe drinking water is the primary goal of public water systems in California. To achieve this goal, public water systems must develop and maintain adequate water treatment and distribution facilities. In addition, the reliability, quality, and safety of the raw water supply are critical to achieving this goal. In general, public water systems depend greatly on the work of other entities to help protect and maintain the quality of the raw water supply. Many agencies and organizations have a role in protecting water supplies in California. For example, the basin plans developed by the Regional Water Quality Control Boards recognize the importance of this goal and emphasize protecting water supplies —both groundwater and surface water.

A public water system is defined as a system for the provision of water for human consumption, through pipes or other constructed conveyances, which has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days of the year (Health and Safety Code, Section 116275[h]).

Public water systems (PWS) are divided into three principle classifications: community water systems (CWS), non-transient non-community (NTNC) water systems, and transient non-community (TNC) water systems. As the name indicates, CWS serve cities, towns, and other residential facilities occupied by year-round users. Examples include everything from apartment complexes served by their own well to systems serving California's largest cities. NTNC systems are PWS that are not CWS and provide water to the same non-residential users daily for at least 180 days of the year. Examples include schools, places of employment, and institutions. TNC systems are places that provide water for a population that mostly comes and goes. Examples include campgrounds, parks, ski resorts, rest stops, gas stations, and motels. Table 15-1 shows the number of public water systems in California by class. Community water systems serve approximately 36.6 million of the estimated 37.7 million people throughout the state, or 97 percent of the state's population. The remaining estimated 1.1 million people in the state (3 percent of the population) receive their drinking water from private wells serving their individual residences or from other sources. Virtually every Californian and visitor to the state will use drinking water from a regulated PWS through their work, while on vacation, or while traveling through the state. Figure 15-1 shows water system class by percent of total number of public water systems in California.

PLACEHOLDER Table 15-1 Public Water Systems in California by Class

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

PLACEHOLDER Figure 15-1 Public Water System Class by Percentage of Systems

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

Under the California Safe Drinking Water Act (SDWA), the California Department of Public Health (CDPH) or CDPH Drinking Water Program has adopted regulations to ensure high quality drinking water

is provided by public water systems at all times. In developing drinking water regulations and carrying out the public water system regulatory program, CDPH recognizes that healthy individuals and communities cannot exist without safe, reliable water supplies. These actions are necessary not only for drinking water, but also to meet basic sanitary and public safety needs.

Drinking water regulations mandated by the California SDWA apply to all public water systems, regardless of ownership. There are two basic water system ownership types - publicly owned and privately owned. Publicly owned systems include municipalities, special districts, and federal or state government systems. Privately owned systems include investor-owned utilities, mutual water companies, mobile home parks, water associations, and may include various commercial enterprises such as restaurants, hotels, resorts, employee housing, or other similar businesses that have their own water supply. While CDPH regulates all public water systems for all aspects that may affect water quality regardless of ownership, the California Public Utilities Commission (CPUC) regulates privately owned, for-profit systems serving communities for the purposes of establishing appropriate water rates. The CPUC regulates sole proprietorships, partnerships, and corporations that provide water service to the public for profit. Mutually owned systems and homeowners associations are exempt from CPUC oversight if they provide water only to their stockholders or members. In addition, systems serving privately owned mobile home parks are also exempt except that CPUC may conduct an investigation into water rate abuses when they receive complaints from residents. Table 15-2 provides a summary of the number and size of the CPUC-regulated water systems.

PLACEHOLDER Table 15-2 Number and Type of CPUC–Regulated Water Agencies

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

At the federal level, the U.S. Environmental Protection Agency (U.S. EPA) is responsible to ensure the implementation of the federal SDWA and related regulations. The State has primacy for the public water system regulatory program in California and works closely with U.S. EPA to implement the program. In addition, local primacy agencies (typically the county environmental health departments) are responsible for regulating many small public water systems (typically those serving less than 200 homes) in 32 of the 58 California counties. U.S. EPA directly provides regulatory oversight for tribal water systems.

Public water systems rely on groundwater, surface water, or a combination of both as their source of supply. Groundwater wells used for drinking water are constructed in a manner to intercept high quality groundwater. Therefore, many groundwater wells require little to no treatment. However, some groundwater wells are impacted by anthropogenic (manmade) and/or naturally occurring contaminants that require treatment to achieve the high level of quality mandated by state and federal regulations for a safe, reliable water supply. All surface water supplies used for drinking water must receive a high level of treatment to remove pathogens, sediment, and other contaminants before being suitable for consumption. Once the water is treated to drinking water standards, this high level of water quality must be maintained as the water passes through the distribution system to customer taps. Water treatment and distribution issues are discussed in detail later in this chapter. There is an increasing effort aimed at preventing pollution and matching water quality to water use. This is described in this volume in Chapter 18, Pollution Prevention and in Chapter 17, Matching Water Quality to Use.

The use of bottled water in the United States has been an increasing trend, however recently that trend appears to have flattened from 2007 through 2011. The Beverage Marketing Corporation and International Bottled Water Association report that U.S. consumption of bottled water was 29.2 gallons per person in 2011 and 29.0 gallons per capita in 2007. In 2005, California ranked No. 1 in the nation for percent of the bottled water share (23.9 percent) and was ranked No. 3 behind Arizona and Louisiana for per capita consumption at 51.2 gallons (Donoho 2007). Some of the reasons that individuals choose bottled water include convenience, image, taste, and perceived health benefits. On the other hand, many consumers are becoming aware of the environmental impact associated with the production, transportation, and waste disposal of bottled water including the contributions to greenhouse gas emissions. While tap water and bottled water are regulated differently, both are generally safe, healthy choices. Tap water provided by a public water system yields public health and fire protection among its other advantages to a modern quality of life. Bottled water costs significantly more than tap water for the volume consumed in cooking and drinking.

Bottled water is regulated by the U.S. Food and Drug Administration under the 1938 Food, Drug, and Cosmetic Act (FD&C Act). California regulates bottled and vended water to a much greater degree than provided in the FD&C Act. The California Sherman Food, Drug, and Cosmetic Law is the basic statute that authorizes such regulation and is implemented by the CDPH Food and Drug Branch.

Drinking Water Treatment in California

Public Health

Water treatment includes processes that treat, blend, or condition the water supply of a public water system for the purpose of meeting primary and secondary drinking water standards. These processes include a wide range of facilities to treat surface water and groundwater. Common surface water treatment facilities include: basic chlorine disinfection, sedimentation basins, filtration, and more recent technical advances such as membrane filtration, ultraviolet light, and ozonation to meet pathogen removal and/or inactivation as well as disinfection requirements while controlling the formation of disinfection byproducts. Common facilities for groundwater sources that require treatment are chemical removal and/or blending facilities. Blending treatment is an acceptable practice for meeting chemical water quality standards and is a process of reducing the contaminant concentration in one water source by blending or dilution with water that has a lower contaminant concentration. Many water systems must also buffer or adjust the pH of the water to ensure that the delivered water is not corrosive in the distribution system and customers' piping. Fluoridation treatment, now commonly practiced in California, may be used to add fluoride to an optimal level that provides dental health benefits.

Widespread treatment of drinking water, especially disinfection, filtration, and fluoridation, was a great public health advancement of the 20th century. The 21st century promises to bring additional advances in water treatment technologies to improve the removal of contaminants, reduce the cost per gallon of treated water, improve water use efficiency (increase water recovery and reduce waste streams), and manage energy consumption. Water recovery, or recycling of water containing treatment process wastes (i.e., filter backwash water, filter rinse water) that would otherwise be disposed, begins with treatment of the recovered or recycled water so it may be blended with raw untreated water at the start of the treatment plant process. This enables a larger percentage of a water supply to be converted to potable water and concentrates the solids generated at the treatment plant. It is important for treatment processes in water-

short areas to maximize the amount of a water supply that can be converted to potable water by reducing the amount of water that is discharged as waste.

California public water systems use an estimated 17,983 groundwater wells and surface water supplies to meet the water supply needs of consumers. Some of these sources need treatment to remove or inactivate harmful contaminants or to meet either aesthetic quality prior to consumption. These could include minerals, metals, chemicals from industry or agriculture, pathogens, and radiological constituents. Currently, there are an estimated 8,560 water treatment facilities in California. Most of these are disinfection facilities provided at sources, treated water storage tanks, or within the distribution system. The remaining systems provide more extensive treatment summarized in Table 15-3.

PLACEHOLDER Table 15-3 Treatment Plants on California Public Water System Sources

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

Fluoridation

Fluoridation of community drinking water has been practiced in the United States for more than 60 years. It is accepted as a safe and effective public health practice for people of all ages. The previous five U.S. Surgeons General have recommended that communities fluoridate their water to prevent tooth decay, the major form of preventable dental disease in America. California's fluoridated drinking water act, Assembly Bill 733, became law in 1995 and required water systems with 10,000 or more service connections to fluoridate once money from an outside source is provided for both installation and operation and maintenance costs. CDPH is also responsible for identifying funds to purchase and install fluoridation equipment for public water systems.

During fluoridation treatment of public water system supplies, water systems adjust fluoride in drinking water to an optimal level shown to reduce the instances of tooth decay. Optimal fluoridation means that the water treatment facility and distribution system is closely managed to provide a consistent level of fluoride at the appropriate prophylactic level to reduce dental disease. Other water systems, that purchase water from a wholesale provider that fluoridates, provide variable fluoridation at levels up to the optimal level. The level of fluoride in these systems depends on many factors, including time of year, water demand, and the use of sources that may not have fluoridation treatment facilities. Additional information on water systems that provide fluoridated water is available at

<http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Fluoridation.aspx>.

Regulation

Both the U.S. EPA and CDPH have ongoing programs for improving public health through new or more stringent drinking water regulations. These regulations include monitoring requirements, maximum contaminant levels (MCLs) in the water provided to the customer, multi-barrier treatment requirements, permitting requirements, public notification, and more. These regulations include specific MCLs for constituents of health concern that are present in drinking water sources. In California, new drinking water standards—the MCLs—are adopted only after development of a Public Health Goal (PHG), which is the level of a contaminant in drinking water below which there is no known or expected risk to health. PHGs are set by the Office of Environmental Health Hazards Assessment, an agency under the California Environmental Protection Agency (Cal EPA). MCLs take into account not only chemicals' health risks,

but also factors such as their detectability and treatability, as well as costs of treatment. The California Health and Safety Code requires CDPH to establish a contaminant's MCL at a level as close to its PHG as is technically and economically feasible, placing primary emphasis on the protection of public health.

In some cases, California adopted MCLs in advance of the federal adoption of an MCL. For example, CDPH adopted a perchlorate MCL of 6 µg/L in 2007. This MCL is based primarily on potential adverse effects on the thyroid. In 2008, the U.S. EPA indicated that it did not intend to adopt an MCL for perchlorate. However, in 2011 the U.S. EPA reversed its earlier decision and now plans to propose a formal rule for perchlorate (U.S. EPA 2011). In September 2012, U.S. EPA posted a Federal Register notice of a public meeting regarding their intent to regulate perchlorate levels in drinking water through adoption of an MCL and anticipates that a draft rule will be available for public comment in 2013.

CDPH is currently in the regulation process to establish an MCL for chromium-6. On July 1, 2011, Cal EPA's Office of Environmental Health Hazard Assessment completed the setting of a PHG for chromium-6 at a concentration of 0.02 µg/l, a necessary prerequisite to adopt an MCL. CDPH is required by law to establish MCLs that are as close to a PHG as are technically and economically feasible. CDPH anticipates that a draft MCL for chromium-6 will be ready for public comment by July 2013. Depending on public comments, the regulatory package for chromium-6 should be formally adopted sometime between July 2014 and July 2015.

In addition, if the adoption of a specific MCL is not practical, U.S. EPA and CDPH have adopted specific treatment performance standards that essentially take the place of an MCL. An example of this is in the various rules for surface water treatment that are intended to provide protection against *Giardia* and *Cryptosporidium*, two microbial contaminants found in surface waters where direct testing is impractical, costly, or lacks the level of reliability necessary in setting an MCL.

New Technology

New or innovative treatment technologies are often developed to address new or more stringent drinking water standards, improve the contaminant removal efficiency, reduce treatment plant footprint, reduce energy consumption, or reduce/eliminate waste streams from the treatment process. Innovative environmental technologies hold the promise of being more effective than traditional methods and can address today's far more complex environmental problems. Technologies increasingly used in California as a result of new regulations include:

- Ultraviolet (UV) disinfection treatment to comply with disinfection byproducts under the Stage 2 Disinfection Byproducts Rule and requirements for the treatment of surface waters under the Long Term 2 Enhanced Surface Water Treatment Rule.
- Arsenic removal technologies including adsorptive (disposable) media to increase affordability of small water system compliance with the arsenic MCL.
- Membrane filtration to comply with requirements of the Long Term 1 and Long Term 2 Enhanced Surface Water Treatment Rules.
- Biological treatment in the form of fixed bed, fluidized bed, and membrane bioreactors to treat for perchlorate and now being demonstrated for nitrate and other contaminants.

As a result of both increases in demand and the relative scarcity of new water supplies, many water providers are now shifting toward treating sources formerly considered unsuitable for domestic use.

Treatment processes such as reverse osmosis are used to desalt brackish shallow groundwater for potable uses and are discussed in greater detail in Chapter 10, Desalination – Brackish Water and Seawater in this volume.

Drinking Water Distribution in California

Treated and/or conditioned water that meets drinking water standards is considered to be “finished water”, suitable for distribution to consumers for all potable water uses. Water distribution systems consist of pipes, storage tanks, pumps, and other physical features that deliver water from the source or the water treatment plant to the customer’s connection. Even high quality drinking water is subject to degradation as it moves through the distribution system to the tap. For example, contaminants can enter the distribution system via backflow from a cross-connection, permeation and leaching, during water main repair or replacement activities, and contamination via finished water storage facilities. Within the distribution system, water quality may deteriorate as a result of microbial growth and biofilm, nitrification, corrosion, water age, effects of treatment on nutrient availability contributing to microbial growth and biofilm, and sediments and scale within the distribution system (U.S EPA 2006).

CDPH has established laws and regulations for the design, construction, operation, and maintenance of distribution systems primarily through the California Waterworks Standards (California Department of Public Health 2008a). Regulations mandate monitoring distribution system water quality for coliform bacteria, chlorine residual, lead, copper, physical water quality parameters, and disinfection byproducts. California has also adopted cross-connection control and backflow prevention regulations to protect water quality within a water distribution system.

In 2000, a federal advisory committee working to develop more stringent U.S. EPA regulations for disinfection byproducts and microbial contamination noted the following as part of its key considerations to develop further regulations in these areas:

- Finished water storage and distribution systems may have an impact on water quality and may pose risks to public health.
- Cross-connections and backflow in distribution systems represent a significant public health risk.
- Water quality problems can be related to infrastructure problems and the aging of distribution systems may increase risks of infrastructure problems.
- Distribution systems are highly complex and there is a significant need for additional information and analysis on the nature and magnitude of risk associated with them.

The maintenance of water quality within the distribution system has received considerable attention in recent years, especially as systems have modified treatment methods. Changes to the methods and levels of disinfectants can create the potential for reduced control of microbial contaminants that may be present in the distribution system.

Water utilities are also constantly making improvements to their distribution systems, including increasing the reliability of their water supply. One example is the installation of emergency water interties between neighboring water utilities. These interties provide a backup source, with the neighboring water system, in case of an outage due to an unforeseen emergency or a potential disaster.

The intertie also allows a water utility to shut down a part of its system to do necessary maintenance without interrupting service to customers.

For example, a number of Bay Area water systems have constructed emergency interties with neighboring water systems. There is an emergency intertie between the East Bay Municipal Utility District (EBMUD), the City of Hayward, and the San Francisco Public Utilities Commission (SFPUC) to supply treated water among the three water systems and is intended to be used during planned outages, for needed maintenance, and to avoid service interruptions. EBMUD has two small interties, each able to carry 4 million gallons per day, with the City of Hayward which adjoins its service area. SFPUC, the agency in charge of the Hetch Hetchy water used by many Bay Area water districts and residents, has also constructed an intertie with the Santa Clara Valley Water Agency and has been considering constructing another intertie. These interties may also play a role in the security of the water distribution system by creating a backup source should a terrorist act or disaster disrupt the source of supply from any single water provider.

In other cases, interties can provide untreated water between utilities in an emergency. For example, Contra Costa Water District (CCWD), whose service area is crossed by EBMUD Mokelumne pipeline, has an intertie which can be used to transfer untreated water between EBMUD and CCWD in an emergency.

Interties are one of the strategies for improving water supply reliability and quality which were recommended by the CALFED August 28, 2000 Record of Decision.

Potential Benefits

Improved water quality can directly improve the health of Californians, thereby improving the state's standard of living and reducing the burden and costs on the state's healthcare system.

Since 1989, a number of rules have been adopted by U.S. EPA and CDPH that are aimed at controlling both microbial pathogens and disinfection byproducts. The first of these rules were the Surface Water Treatment Rule (1989) and the Total Coliform Rule (1989). Both rules intended to reduce the risk to consumer of both viral and microbial pathogens in drinking water. As the regulatory community became more aware of the risks posed by organisms such as *Giardia*, *Cryptosporidium*, and certain enteric viruses present in surface water supplies, rules were adopted to address these risks and increase the degree of protection for consumers. These rules included:

- Interim Enhanced Surface Water Treatment Rule (1998).
- Filter Backwash Rule (2001).
- Long Term 1 Enhanced Surface Water Treatment Rule (2002).
- Long Term 2 Enhanced Surface Water Treatment Rule (2005).

Concurrently, rules were adopted to improve the disinfection process while at the same time providing protection against two groups of disinfection byproducts, trihalomethanes (TTHM) and haloacetic acids (HAA5). The following disinfection byproduct rules were adopted:

- Stage 1 Disinfection Byproducts Rule (1998).
- Stage 2 Disinfection Byproducts Rule (2006).

In addition to the surface water rules, U.S. EPA adopted the Groundwater Rule (2006) to increase the level of protection primarily from enteric viruses.

The perchlorate MCL and the arsenic MCL reduce the permissible level of these contaminants and result in direct benefits. Perchlorate exposure is a public health concern because it interferes with the thyroid gland's ability to produce hormones. In the very young, hormones are needed for normal prenatal and postnatal growth and development, particularly for normal brain development. Therefore, a reduction in thyroid hormones is a serious concern. In adults, thyroid hormones are needed for normal body metabolism. About 515,000 people in California will avoid exposure to perchlorate at levels above the MCL annually as a direct result of the perchlorate regulation (California Department of Public Health 2007). The arsenic MCL of 10 ug/L will result in an exposure reduction for more than 790,000 people and a theoretical reduction of 57 lung and bladder cancer cases per year in California (California Department of Public Health 2004).

Adequate operation and maintenance of the distribution system network will reduce delivery problems (main or tank ruptures, water outages) and ensure delivery of high quality water. In California, operators of drinking water distribution systems must be certified at the appropriate level depending on the size and complexity of the distribution system. This certification requirement helps to ensure a competent level of operation of distribution systems.

Similarly for water treatment facilities, proper operation and maintenance is essential for achieving optimum water treatment plant performance. In California, operators of drinking water treatment facilities must be certified at the appropriate level depending on the size and complexity of the treatment facilities.

Water fluoridation ranks as one of ten great public health achievements of the 20th century according to the U.S. Surgeon General in 2000. Fluoridation of public water supplies targets the group which would benefit the most from its addition, namely infants and children under 12, by decreasing cavities and improving dental health. Studies have shown unequivocally that fluoridation, at the optimal concentration, reduces the incidence of dental caries by 50-70 percent. It has also been demonstrated that caries will increase if water fluoridation is discontinued in a community for an extended period. One example is what happened in Antigo, Wisconsin. Antigo started fluoridating its community water supplies in 1949 and discontinued it in 1960. Five and one-half years later, second graders had more than 200 percent more tooth decay, fourth graders had 70 percent more, and sixth graders had 91 percent more tooth decay than children of the same age in 1960 (California Department of Public Health Community Water Fluoridation Program 2009).

Potential Costs

The cost of providing drinking water in compliance with all drinking water standards is steadily increasing due to increasing costs for energy and materials and increasing regulations requiring higher levels of treatment. Water bills reflect the costs of pumping, treating, and delivery of water as well as the operation and maintenance of the system, water quality testing, and debt repayment. Water treatment costs may include the cost of chemicals, energy, and operation and maintenance of the treatment facilities. Drinking water treatment costs will vary widely from plant to plant. Many different factors can affect the cost of water treatment, including the choice of which water treatment technology to use.

Table 15-4 summarizes the past and future estimated costs of treated full-service water provided by the Metropolitan Water District of Southern California (MWD), which treats a blend of surface water from the Colorado River and the California Aqueduct. The table shows an increase of approximately 65% from 2007 to 2012 in the cost to provide treated water in an area serving a large rate base. The additional cost reflects improvements to the treatment provided, increased cost for chemicals and energy, and reduced availability of new water supplies. The primary cost factors causing the rate increase included increased conservation efforts, the quagga mussel control program, litigation, and the higher cost for State Water Project deliveries. MWD may not capture the true cost of service with these rates and must cover some costs through the use of reserves.

PLACEHOLDER Table 15-4 Metropolitan Water District of Southern California Treated Water Rate History

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

The increase in cost to provide safe drinking water for smaller systems may be significantly greater on a per capita basis. These systems lack the economy of scale necessary to achieve savings in their day-to-day operations. In addition, most small systems have not set up any assets management plan or created a capital improvement account as a means to fund infrastructure replacement.

Per household costs for compliance with new regulations for small water systems can be more than four-fold higher than those for medium-to-large water systems (U.S. EPA 2006). Where substantial areas are impacted by contamination, such as the nitrate contamination in the Tulare Lake basin and Salinas Valley, the cost to consumers can be significant. According to a recent UC Davis study titled Addressing Nitrates in California's Drinking Water – Technical Report 7: Alternative Water Supply Options (Honeycutt K, Canada HE, Jenkins, MW, Lund JR 2012), about 2.4 million people receiving groundwater supplies from community water systems and state small water systems are potentially impacted by nitrate in the Tulare Lake basin and Salinas Valley study areas. In addition, about 245,490 persons in these areas obtain water from unregulated private water supplies that may also be subject to nitrate contamination. According to the UC Davis study, the estimated cost per person to provide safe water (water that meets nitrate standards) is estimated to be between \$80 and \$142 per year. For a typical public water system customer, this cost represents an estimated increase in the monthly water bill from \$23 to \$42/month based on \$80 to \$142/yr. x 3.5 persons per household.

The most prevalent groundwater contaminant is arsenic, a naturally occurring contaminant, affecting an estimated 287 community drinking water system statewide (State Water Resources Control Board 2012). The average annual cost per household to comply with the arsenic MCL is estimated to range from \$140 to \$1,870 per residence depending on the size of the water system (California Department of Public Health 2008b). These costs are in addition to current costs for drinking water.

Up to one-third of the operations and maintenance costs for some water utilities are energy related, including energy used for water treatment and pumping. One factor in water-related energy consumption is using new technologies that are more energy intensive than most previous treatment technologies e.g., UV treatment and high pressure membranes.

Desalination will play an increasing role in California's water supply, both for brackish groundwater desalination and seawater desalination. Historically, the high cost and energy requirements of desalination had confined its use to places where energy is inexpensive and freshwater is scarce. Recent advances in technology, especially improvements in membranes, have made desalination a realistic water supply option. The cost of desalinating seawater is now competitive with other alternatives in some locations and for some high-valued uses. However, although process costs have been reduced due to the newer membranes that allow for lower energy consumption, the total costs of desalination, including the costs of planning, permitting, and waste salt brine concentrate management remain relatively high, both in absolute terms and in comparison with the costs of other alternatives (National Resource Council 2008). Since development of other traditional sources of supply is limited and may require substantial capital investment, such as new storage or canal systems, the expanded development of brackish water and seawater desalination may become more cost competitive.

The condition of infrastructure is a growing concern in California and throughout the country. In the *Report Card for America's Infrastructure*, the American Society of Civil Engineers gave drinking water infrastructure across the country a D-minus. The U.S. EPA conducted a Drinking Water Infrastructure Needs Survey and Assessment in 1995, 1999, 2003, 2007, and 2011 (results are still being compiled by U.S. EPA). The 2007 survey shows a total investment need of \$334.8 billion over the next 20 years nationwide. It identified a total investment need of \$39.0 billion for California. This is more than 11 percent of the national need. The majority of the California need was for transmission and distribution systems (59%, or \$22.98 billion). The second highest need category was for treatment (20%, or \$7.5 billion), followed by water storage (15%, or \$5.7 billion), and water source (6.4% or \$2.5 billion) (All amounts are in January 2007 dollars). This does not include the infrastructure needs of tribal water systems that are regulated directly by U.S. EPA as tribal nations. See the following link for information about these systems:
http://water.epa.gov/infrastructure/drinkingwater/dwns/upload/2009_03_26_needssurvey_2007_report_needsurvey_2007.pdf . California's investment needs may not include all cost associated with changes in the Colorado River water resources, recent or evolving drought issues, or changes to groundwater basins.

Funding for drinking water projects on tribal lands is provided by the federal government as part of the Drinking Water Infrastructure Grants: Tribal Set-aside Program, which was established by the federal Safe Drinking Water Act reauthorization of 1996. The program allows the U.S. EPA to award federal grants for infrastructure improvements for public drinking water systems that serve tribes.

Major Implementation Issues

Based on a review of issues discussed within the water supply industry and regulatory agencies, the following topics represent some of the most significant challenges for public water suppliers and the regulatory agencies today.

Deteriorating Infrastructure

With the aging of the nation's infrastructure and the growing investment needed to replace deteriorated facilities, the water industry has a significant challenge to sustain and advance its achievements in protecting public health and the environment (Grumbles 2007). During the last several decades, the public investment has been toward expanding and upgrading service levels, such as providing higher levels of treatment.

New solutions are needed for critical drinking water investments over the next two decades. Many utilities are moving to the concept of asset management to better manage and maintain their water facilities and infrastructure (Cromwell et al. 2007) for greater operational efficiency and effective use of limited funds. However, addressing the replacement of deteriorating infrastructure will add to the cost of water.

Asset management alone will not fix the basic problem. Particularly in smaller systems, inadequate funding for capital improvement plans for infrastructure replacement has created a serious problem. From the post-war period of the late 1940s and into the early 1980s, there was a proliferation of small community water systems located in rural areas and remote from the cities. In the past, such systems could often fund major maintenance and needed infrastructure replacement with informal assessments from the rate payers. However, the magnitude of the current infrastructure needs makes it very difficult to finance without creating an inordinate burden on rate payers.

CDPH has funding ‘set-asides’ from the Drinking Water State Revolving Fund (DWSRF) program to provide technical assistance to small water system operators and managers for technical, managerial, and financial areas. Additional funding would allow the expansion of this program into more detailed areas of asset management and rate setting.

Source Water Protection

There is an increasing need to protect source water quality as the first critical barrier in the multiple barrier approach to provide safe drinking water. A key issue is the increasing difficulty of protecting source water quality as the state population increases which results in increased wastewater discharge and urban runoff into surface water supplies. Another major issue is that some drinking water contaminants (organic carbon, nutrients, and pathogens such as *Giardia* and *Cryptosporidium*) are not currently regulated by the Regional Water Quality Control Boards in basin plans. Thus, there are generally no requirements for dischargers to control these contaminants.

Inadequate Financial Assistance to Address Both Water Treatment and Infrastructure Issues of Public Water Systems

The four major funding programs for California public water systems are DWSRF, Proposition 50, Proposition 84, and the American Recovery and Reinvestment Act of 2009 (ARRA). Combined, these programs have provided more than \$1.87 billion to 441 public water systems to solve health risk problems and Safe Drinking Water Act violations, resulting in an overall risk reduction for consumers. However, this funding has not been adequate to address all of California’s identified needs. The combined project priority list for these funding programs includes more than 4,000 projects, many of which have been on the list since its inception in 1997 and have not received funding. The estimated value of unfunded need on the combined project priority list exceeds \$12 billion is shown in Table 15-5.

PLACEHOLDER Table 15-5 California Department of Public Health Summary of Funded and Unfunded Projects

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

The CDPH Drinking Water Program administers multiple funding programs to assist water systems to achieve and maintain compliance with safe drinking water standards. These programs use federal funds and state funds to address the highest priorities of the total infrastructure need.

Safe Drinking Water State Revolving Fund

The largest funding program CDPH administers is the Safe Drinking Water State Revolving Fund (SDWSRF). The U.S. EPA provides SDWSRF funds to states in the form of annual Capitalization Grants. States, in turn, provide low interest rate loans and other assistance to public water systems for infrastructure improvements. In order to receive a federal SDWSRF Capitalization Grant, states must have statutory authority for the program and must provide a state match equal to 20 percent of each annual Capitalization Grant. Pursuant to state statutes (Health and Safety Code, Division 104, Part 12, Chapter 4.5 commencing with Section 116760, Safe Drinking Water State Revolving Fund Law of 1997), CDPH is authorized to receive the federal Capitalization Grants and administer the SDWSRF program in California. California's SDWSRF program began in 1998 and issued its first loans in 1999. California's current share of the national SDWSRF is 9.35% (see Table 15-6) and it is the highest allocation of all states.

PLACEHOLDER Table 15-6 California Safe Drinking Water State Revolving Fund: Capitalization Grants from the U.S. EPA

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

Total SDWSRF funding provided to public water systems in executed loans and grants to date is more than \$1.3 billion. Approximately 80 percent of these funds are distributed by CDPH as subsidized interest rate loans to public water systems serving disadvantaged communities. The remainder is distributed in the form of grants to disadvantaged communities. Water systems determined to serve a disadvantaged community receive a zero percent interest rate loan and may receive grant funding. Disadvantaged communities are communities with a median household income (MHI) less than or equal to 80% of the statewide MHI and may receive grant funding up to 80% of the project costs based on affordability criteria. Severely disadvantaged communities are communities with a MHI less than or equal to 60% of the statewide MHI and may receive grant funding up to 100% of the project costs based on affordability criteria.

The majority of the SDWSRF funding is subsidized, low interest rate and zero interest rate loans that typically have a 20-year repayment term. All loans are secured, however the security varies and is most often provided by user water rates, charges, and/or surcharges. As the outstanding loans are repaid, they generate a steady repayment stream that currently exceeds \$40 million per year. In accordance with state and federal SDWSRF laws, the funds from the repayment stream are added to the SDWSRF fund and can be utilized in the same manner.

SDWSRF Funding Priority

In accordance with federal requirements and state law, CDPH establishes the priority for SDWSRF funding based on the risk to public health. Each pre-application submitted for funding is evaluated and if eligible for funding is assigned a category, based on the problem to be addressed. Highest categories are

problems associated with bacteriological pathogens, followed by nitrate, and then other chemicals that exceed primary (health-based) drinking water standards.

After the appropriate funding category is determined, CDPH further prioritizes projects based on bonus points. Bonus points are used to rank projects within a category. The addition of bonus points will not move a project from one category to another. To the extent feasible, when a group of systems is invited to complete the application process for SDWSRF funding, all the systems within that category seeking funding that year are invited to apply. Bonus points are assigned based on affordability, consolidation, type of water system, and population.

CDPH factors in affordability by comparing the MHI of the community served by the proposed project to the statewide MHI level. Communities that are below the statewide average MHI level receive additional ranking consideration. This gives poorer communities a higher ranking within a category than communities with higher income levels.

For purposes of ranking projects within a category, any project that includes consolidation of separate existing water systems will receive additional ranking points. Consolidation ranking points support projects that will provide reliability, efficiency, and economy of scale that can be achieved with larger water systems while discouraging the proliferation of numerous separate small systems that have inherent inefficiencies and limitations.

The type of water system is considered in prioritizing because there is a relatively higher health risk associated with persons who drink the same water each day over a period of time, known as accumulated exposure. Thus, community and non-transient non-community water systems are ranked above transient non-community systems within a category and with the same bonus ranking points.

All projects within a category that have the same number of ranking points and are the same type of system are ranked in ascending order based on the population served by the water system. Smaller populations are ranked above higher populations.

CDPH combines all these factors to develop a Project Priority List (PPL) each year. CDPH then invites projects for funding from the PPL. Recently, Congress has required states to commit 20% of the SDWSRF funds to “green projects” such as water or energy efficiency, green infrastructure, or other environmentally innovative activities. CDPH has awarded a portion of the funding to install water meters in disadvantaged communities.

American Recovery and Reinvestment Act

The American Recovery and Reinvestment Act was signed by President Obama on February 17, 2009. ARRA allocated \$2 billion nationally for safe drinking water infrastructure improvements. California’s share of these funds is \$159 million and is administered by CDPH through its existing SDWSRF program. The ARRA funds were a one-time opportunity and did not require state matching funds.

CDPH issued funding agreements totaling \$149 million to 51 projects statewide. These 51 projects are distributed among 47 community drinking water systems. The funds were committed to drinking water infrastructure projects that were identified as “ready to proceed.” All funding agreements were issued by

December 2009 and all projects were under construction by February 2010. The ARRA-funded projects are in different stages of construction and all must be completed by June 30, 2013.

Proposition 50

Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (Water Code Section 79500, et seq.) was passed by California voters in the November 2002 general election. CDPH is responsible for portions of the Act that deal with water security, safe drinking water, and treatment technology. This approved bond measure allocated \$485 million to CDPH to address drinking water quality issues in California. Proposition 50 authorizes up to 5 percent of the funding for CDPH to administer the funding programs listed below. In addition, 3.5 percent must be allocated for bond costs. Under Proposition 50, CDPH is also responsible for multiple funding programs described below.

Chapter 3, Water Security

Water Code Section 79520 provides \$50 million to CDPH to protect state, local, and regional drinking water systems from terrorist attacks or deliberate acts of destruction or degradation. These funds may be used for

- Monitoring and early warning systems.
- Fencing.
- Protective structures.
- Contamination treatment facilities.
- Emergency interconnections.
- Communications systems.
- Other projects designed to
 - Prevent damage to water treatment, distribution, and supply facilities.
 - Prevent disruption of drinking water deliveries.
 - Protect drinking water supplies from intentional contamination.

CDPH developed criteria that prioritized Chapter 3 funding to water systems to construct emergency interties with adjacent water systems. Emergency intertie connections ensure there is an alternate connection to a water system if there is a disruption in water supplies during emergencies, such as natural catastrophes or terrorist attacks. This provides additional assurance of continuous water supplies to the largest populations.

Chapter 4, Safe Drinking Water

Water Code Section 79530 provides funding to CDPH for grants for public water system infrastructure improvements and related actions to achieve safe drinking water standards.

Section 79350(a) (Chapter 4a) provides \$70 million for grants to small community water systems (less than or equal to 1,000 service connections or less than or equal to 3,300 persons) to upgrade monitoring, treatment, or distribution infrastructure. It also provides grants for community water quality monitoring equipment, drinking water source protection, and treatment facilities necessary to meet disinfection byproduct drinking water standards. CDPH developed criteria that prioritized Chapter 4a funding to water systems based on public health risk, using the SDWSRF categories as well as other criteria specific to the funding section. In addition, the criteria give priority to disadvantaged communities within each category.

Section 79350(b) (Chapter 4b) provides \$260 million for grants to Southern California water agencies to assist in meeting California's commitment to reduce Colorado River water use to 4.4 million acre-feet per year. CDPH developed criteria that prioritized Chapter 4b funding to water systems in accordance with the bond language. Projects are assigned points based on three ranking criteria and a cumulative score is determined for each project. The projects are then ranked by that score from lowest to highest. Criterion 1 ranks projects by Proposition 50/AB 1747 categories and by water system population (from highest to lowest) within a category. Criterion 2 ranks projects by reduction of the annual volume of Colorado River water demand. Criterion 3 ranks projects by the cost per volume of the reduced demand.

Proposition 84

Proposition 84, the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Act of 2006 (Public Resources Code Section 75001, et seq.) was passed by California voters in the November 2006 general election. This approved bond measure allocated \$300 million to CDPH to address drinking water and other water quality issues in California. Proposition 84 authorizes up to 5 percent of the funding for CDPH to administer the funding programs. In addition, 3.5 percent must be allocated for bond costs. Within Proposition 84, CDPH is responsible for multiple funding programs listed below.

- Section 75021 provides \$10 million for grants and direct expenditures for emergency and urgent actions to ensure safe drinking water supplies. CDPH developed criteria to determine the eligibility of Emergency Grant projects. All requests that meet the eligibility criteria are funded until the funds are exhausted. Factors that CDPH considers include:
 - Type of contaminant(s).
 - Degree of contamination.
 - Whether the health hazard is acute (immediate) or chronic (long-term).
 - Length of time to which consumers have been or will be exposed.
 - Any actual or suspected illnesses.
 - Any actions taken by the local Health Officer or the local Director of Environmental Health.
 - Other funds to resolve the public health threat or emergency.
 - Duration and extent of a water outage due to an emergency.
 - Duration and extent of loss of power due to an emergency.
- Section 75022 provides \$180 million in grants for small community drinking water system infrastructure improvements for chemical and nitrate contaminants and related actions to meet safe drinking water standards. \$7.5 million is allocated, pursuant to 2011-2012 Budget Act, to projects in the City of Santa Ana and the City of Maywood.

CDPH developed criteria that prioritize eligible projects in accordance with the bond language and subsequent legislation. Projects were scored by points based on:

- Regulatory status of the principal contaminant to be addressed.
- Health risk associated with the principal contaminant to be addressed.
- Number of contaminants in the project's drinking water supply that exceed a primary drinking water standard.
- Median household income of the applicant water system.

- Project includes consolidation.
- Project is part of a regional project.
- Section 75025 provides \$60 million for immediate projects needed to protect public health by preventing or reducing the contamination of groundwater that serves as a major source of drinking water for a community. \$2 million of the funding is allocated, pursuant to SB X2 1, to the State Water Resources Control Board to develop pilot projects in the Tulare Lake basin and the Salinas Valley that focus on nitrate contamination.

CDPH developed criteria that prioritize eligible projects in accordance with the bond language and subsequent legislation. Projects were scored by points which are based on the regulatory status of the principal contaminant to be addressed; the health risk associated with the principal contaminant to be addressed; the number of contaminants in the project's drinking water supply that exceed a primary drinking water standard; the median household income of the applicant water system; whether the project includes consolidation; and whether the proposed project is part of a regional project.

Regionalization/Consolidation

One way to improve the economy of scale, which results in the potential for many benefits including lower costs, is to increase regionalization of water supply systems. This can be achieved by physical interconnections between water systems or managerial coordination among utilities. CDPH has established a requirement for evaluating consolidation as part of every project funded under the available financial assistance programs. To address deteriorating infrastructure successfully for the hundreds of smaller public water systems in California, regionalization and consolidation may be necessary on a larger scale. It is not cost-effective for a small system to replace aging and deteriorated sources, treatment plants, and distribution systems fully. However, with a larger rate base to spread costs across, the economies of scale improve for consolidated systems. Managerial consolidation of water districts, even where the boundaries are not contiguous, can provide great savings to the consumers by sharing the costs of oversight and management of the systems, thus freeing up funds for system upgrades. Box 15-1 describes a regional consolidation project in the planning stages.

PLACEHOLDER Box 15-1 Rosamond Community Services District Regional Consolidation Project

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

Disadvantaged Communities/Environmental Justice

There has been heightened interest in environmental justice issues as a result of nitrate contamination problems in public water systems, particularly those in agricultural areas such as the Central Valley. It is the role of the federal government to ensure that, in the development and implementation of new regulations, disadvantaged communities are protected at levels afforded to other demographic communities. Presidential Executive Order 12898 establishes a federal policy for incorporating environmental justice into federal agencies' missions by directing them to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations.

Each of the three major water system funding programs implemented by CDPH provides some special financing for water systems that serve areas with relatively low median household income. For example, the SDWSRF can provide grant funds and zero-interest loans to water systems serving a community with a low MHI as stated earlier. Proposition 50 funding has a target goal to provide 25 percent of the funding to low-MHI communities. A significant portion of the Proposition 84 funds allocated to drinking water are specifically targeted at small disadvantaged communities with contamination problems. Funding from both Propositions 50 and 84 is limited due to the one-time allocation specified for drinking water.

Impact of Climate Change

Climate change projections include warmer air temperatures, diminishing snowpack, precipitation extremes and storm intensity, prolonged droughts, and sea level rise. These anticipated changes could affect water quality in regions that are already experiencing difficulty meeting current water demands.

Earlier snowmelt and more intense episodes of precipitation with increased flood peaks may lead to more erosion, resulting in increased turbidity and concentrated pulses of pollutants in source waters. Increased flooding may lead to sewage overflows, resulting in higher pathogen loading in source waters. These potential changes could result in challenges for surface water treatment plants and may require additional monitoring to quantify changes in source water quality and to meet post-treatment drinking water standards.

Increased water temperatures and reduced reservoir levels may result in more prevalent eutrophic conditions, increasing the frequency and duration of algal blooms. Higher water temperatures can also accelerate some biological and chemical processes, such as increasing growth of algae and microorganisms, depletion of dissolved oxygen, and various impacts to water treatment processes. Higher sea levels as a result of climate change could impact coastal groundwater basins by making protection of groundwater from seawater intrusion more difficult.

Adaptation

Increasing demand on limited and valuable water resources available in California will compound any climate change impact. The continued growth in the state will continue to stress the availability of the freshwater resources needed for domestic, agricultural, and industrial uses. California coastal water providers have begun evaluating and employing desalination of seawater as an additional drinking water supply. Desalinated seawater, although more expensive to develop due to the high energy requirements and planning and permitting costs, has been identified as a reliable drought-proof supply.

Regionalization of water supply systems as an adaptation strategy will also help counter the effects of climate change by adding operational flexibility during periods of drought or flooding. Investments in drinking water facilities and conveyance systems will add efficiency and lead to enhanced sustainability in the future. Adaptation to climate change to provide adequate drinking water will likely require specific regional strategies described in this chapter that focus on conservation, sustainability, and operational flexibility.

Mitigation

Demand for drinking water treatment and distribution will continue to increase as climate change has major impacts on water quality and availability of the freshwater resources used for drinking water.

Adverse impacts on climate change related to increasing greenhouse gas emissions could result from energy uses in 1) drinking water treatment and distribution systems, 2) bottled water production including related transportation and waste disposal, and 3) treatment of new sources of drinking water from low quality groundwater and recycled wastewater. However, improving water and energy efficiency from management strategies described in this chapter could have benefits that reduce energy uses and greenhouse gas emissions as part of climate change mitigation including:

- Promoting opportunities to use more tap water and less bottled water to reduce related energy and greenhouse gas emissions.
- Conducting audits for water and energy efficiency in drinking water treatment and distribution systems.
- Providing operational efficiency and improving aging infrastructure to control water losses for water and energy saving.
- Developing programs and applying new technologies to reduce energy use in both water treatment plants and for new sources of drinking water such as low quality groundwater and recycled wastewater.
- Developing energy efficiency standards for drinking water treatment and distribution systems.
- Coordinating with water use efficiency programs and using best management practices to save water and energy such as utility leak detection, water conservation, and water efficiency pricing and incentives for installing water efficient appliances and landscaping.

Water Use Efficiency

The efficient use of water is regarded as a viable complement, and in some instances a substitute, to investments in long-term water supplies and infrastructure. Water use efficiency is a concept to maximize the use of water or minimize its waste. Water use efficiency will continue to be a key element of addressing reduced water availability and is regarded as a major step to take before turning to more costly water sources such as desalinated seawater. Water efficiency programs and practices may include utility leak detection, water conservation programs, water efficiency pricing and incentives for installing water efficient appliances and landscaping, as well as improvements in water recovery as part of water treatment plants (e.g., recycling water used in treatment plant processes for backwash).

An important aspect of strongly encouraging water conservation is the ability of the water utility to establish an escalating metered rate based on the volume of water used. This promotes full cost recovery, conservation, or efficiency pricing. Since 1992, California law has required urban water suppliers (those serving more than 3,000 connections or delivering more than 3,000 af of water per year) to install a water meter on new connections. More recently, AB 2572 established the requirement for retrofitting water meters on pre-existing connections and charging customers for water based on the actual volume of water used. Neither of these laws addresses smaller water systems that do not meet the definition of an urban water supplier.

However, many larger water agencies have already taken advantage of conservation programs to reduce the need for new water supplies. The Los Angeles Department of Water and Power (LADWP) has shown success in conservation where water use today is the same as it was 25 years ago, despite a population increase of nearly 1 million people (City of Los Angeles Department of Water and Power 2008). Obtaining additional conservation increases will be more difficult and may result in higher costs to achieve.

To address water losses or unaccounted water, water utilities conduct audits to identify water main leaks, unmetered water use for parks and recreation consumption, water theft, and inaccurate meters. Deteriorated and aging infrastructure can play an important role in water losses which contributes to significant water leakage and a high rate of water main breaks. Nationally, there has been reported water losses by utilities of between 10% to nearly 50% of the water produced. Due to the continued aging of distribution infrastructures that are at or near the end of their useful life, water losses due to water main leaks can be expected to remain a significant and potentially increasing barrier to California's efforts to conserve water. Both the Safe Drinking Water State Revolving Fund program and the American Recover and Reinvestment Act administered by CDPH, provide funding to drinking water systems for water meter installation. Water meters are an important tool to measure water losses in the distribution system.

Maintaining a Trained Workforce

California requires operators of water treatment plants and distribution systems to receive certification to perform these duties. This certification is designed to ensure that operators have adequate knowledge, experience, and training to operate these facilities properly. Due to the increased complexity of water system facilities, the importance of properly trained and certified operators is increasing.

Sustaining a trained workforce to maintain an adequate level of qualified oversight at water treatment plants and operation of distribution systems has been identified as an important issue. This is, in part, due to the increased number of people from the large Baby Boomer generation beginning to leave the workforce. CDPH data indicate that the average age of operators certified in California is about 50, and the average age of Grade 5 treatment plant operators (the highest treatment certification available) is greater than 55 (Jordan 2006). Many water utilities will lose 30 to 50 percent of their current workforce within the next 5 to 7 years, which will result in an unprecedented knowledge drain. A knowledge retention strategy is necessary to ensure long-term success.

Knowledge retention, broadly termed succession planning, is the process of identifying and preparing suitable employees through mentoring, training, and job rotation to replace key staff, such as treatment or utility managers, within an organization as current managers retire. Succession planning will become more important in the near future to ensure the transfer of knowledge as less experienced staff moves into higher decision-making positions. This issue applies to both the public and private water sector, as well as to the government agencies that regulate the water industry. Graduating engineering students show a noticeable lack of interest in the water industry.

In November 2006, CDPH introduced the Expense Reimbursement Grant Program (ERG) for small water system operators using a U.S. EPA grant. ERG provided funding for small water system operators to receive reimbursement for training to become certified operators or to maintain and advance their operator certification levels. This program provided training reimbursement for operators until all funding was expended in early 2011.

Treatment Technologies for Small Water Systems

Providing safe and affordable drinking water is still a significant challenge for small water systems. Economies of scale typically become more limited for the small system size categories, resulting in per-household costs for compliance with new regulations that can be more than four times higher than those for medium-to-large water systems (U.S. EPA 2006). There have been advances in the effective use of

point-of-use (POU) and point-of-entry (POE) technologies for certain contaminants under controlled circumstances for some small drinking water systems (Cadmus Group 2006). POU devices are those that treat water at the location where it is consumed, such as at the tap or a drinking fountain. POE devices are those that treat all of the water entering a home or building, not just water that is consumed. POE technologies treat all water that a consumer comes in contact with, such as bathing and handwashing, while a POU device provides treated water at one tap intended for drinking and cooking and is usually installed in the kitchen. The California SDWA allows the consideration and approval of POE for compliance with drinking water standards where it can be demonstrated that centralized treatment at the wellhead or surface water intake is not economically feasible. The California SDWA also allows the consideration of POU devices as per the above and provided they also demonstrate that the use of POE devices is either not economically feasible or POE devices would not be as protective of public health as POU devices. Specifically, only systems serving less than 200 connections may be eligible to use POU or POE devices and they must first demonstrate: 1) that the installation of centralized treatment is not immediately economically feasible, 2) that usage of the POE or POU device is allowed under the Federal Safe Drinking Water Act for the specific contaminant, and 3) that the water system has submitted a pre-application for funding to correct the violation for the contaminant that the POE or POU device is proposed to treat.

New treatment technologies that are cost-effective and do not require extensive operator attention are often needed to address chemical contaminants that affect small water systems. Proposition 50 provided funding to demonstrate some of these technologies. As new technologies are proposed to treat water to drinking water standards, CDPH must review and approve these technologies and use staff dedicated to reviewing these technical aspects of drinking water treatment.

Treatment Residuals Disposal

In many areas, treatment options for contaminants are limited due to residual disposal issues. For example, the disposal of brine from ion exchange and reverse osmosis treatment has been identified as a potential source of salinity in groundwater. California, and especially the central San Joaquin Valley, is experiencing increased salts in the groundwater. As the salinity of local groundwater sources increase, more water customers use water softeners to improve the quality at their tap. This, in turn, results in a higher discharge of salts to the wastewater treatment plants which increases the salinity of wastewater and exacerbates the problem. The Central Valley Regional Water Quality Control Board completed a study in May 2006 on salinity in groundwater in the Central Valley which introduced the concept of a long-term salinity management program for the Central Valley and for California (Central Valley Regional Water Quality Control Board 2006). Additional information is available in Chapter 19, Salt and Salinity Management.

Disposal of residuals, such as backwash water or spent media, poses additional costs for water treatment, especially those that may be classified as a hazardous or radioactive waste due to the concentration and leaching characteristics of the contaminant. Selection of treatment alternatives, especially for arsenic, must consider disposal issues. The spent treatment plant media must be evaluated under the California Waste Extraction Test (WET) for classification prior to determining appropriate disposal options due to the potential for the arsenic to leach from the media in a landfill environment. The California WET classification is more stringent than federal leaching tests. The City of Glendale water system conducted a

study that evaluated treatment alternatives for removal of chromium-6 that included disposal of treatment residuals. See Box 15-2 for additional information.

PLACEHOLDER Box 15-2 City of Glendale Chromium-6 Treatment Residuals Disposal Study

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

Security of Drinking Water Facilities

Water system facilities are vulnerable to security breaches, acts of terrorism, and natural disasters (all-hazards). Both water system personnel and the general public have developed a greater awareness of the vulnerability of California's critical infrastructure and key resources because of the events of September 11, 2001, Hurricane Katrina in 2005, and many other disasters and incidents since then. The enhancement of security and emergency response and recovery capabilities are crucial to maintain a reliable and adequate supply and delivery of safe, clean, and wholesome drinking water. Just as crucial are forming, developing, and exercising relationships with partners and stakeholders.

Under the U.S. Public Health Security and Bioterrorism Preparedness and Response Act of 2002, drinking water utilities serving more than 3,300 people were required to conduct Vulnerability Assessments and develop/update their Emergency Response Plans to address these vulnerabilities. All of California's water utilities in this category have prepared these documents. These documents and their implementation are an important element in building and maintaining the ability to respond to security breaches and other catastrophes and to recover from them.

The accomplishments by the water industry, the wastewater industry, and regulatory agencies to protect California's water and wastewater facilities from all-hazards include:

- Emergency Water Quality Sample Kit (EWQSK) developed by CDPH and based on the U.S. EPA Response Protocol Toolbox. These sample kits provide water systems with a resource to sample drinking water quickly for an unknown contaminant during a credible event.
- Partnerships between water agencies and the regulatory community were established to address emergency response and recovery, including the California Water/Wastewater Agency Response Network (CalWARN), Laboratory Response Network (LRN), and the California Mutual Aid Laboratory Network (CAMAL Net). WARN systems facilitate a utilities-helping-utilities approach by providing assistance during a crisis. By establishing mutual aid agreements before a crisis occurs, WARN participants pave the way for member utilities within and outside of their respective regions to send valuable aid in a quick and efficient manner. WARN participants can access specialized resources to assess and assist water and wastewater systems until such time as the system can develop a permanent operating solution.
- Water Infrastructure Security Enhancement (WISE) Guidelines, drafted for the Physical Security of Water/Wastewater Utilities by national water and wastewater organizations, provide recommendations for the management, operation, construction, and retrofit of water and wastewater treatment plants and distribution/collection systems to enhance physical security. The WISE Guidelines are at <http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Security.aspx>.
- Coordination among partners and stakeholders and developing those relationships are critical to a successful response and recovery, and to improving situational and operational awareness. The water and wastewater communities and respective regulatory organizations

have formed many groups to accomplish this critical network that meet periodically and communicate regularly. These groups include:

- InfraGard that was created and sponsored by the Federal Bureau of Investigation as a public/private information sharing and analysis collaborative. It was established since the majority of critical infrastructures and key resources are owned and operated by private entities.
- Local Terrorism Early Warning Groups (TEWG) that meet to exchange information and discuss local and national issues.
- Water ISAC, a Department of Homeland Security- recognized center, that provides water and wastewater information sharing and analysis.
- Recognizing that communication during a crisis can make or break a successful response, the CDPH used the Centers for Disease Control and Prevention Crisis and Emergency Risk Communication (CERC) Toolkit and modified it specifically for the water and wastewater community. CDPH has conducted numerous CERC training classes detailing the toolkit and espousing the virtues of being prepared to address risk communication during a crisis.
- A successful response and recovery is also strongly dependent upon exercising the policies, procedures, processes, and partnerships. To that goal, the regulatory communities are providing training to the water and wastewater communities on designing and conducting tabletop exercises. Tabletop exercises are a low cost, low stress process by which partners can work together on scenarios and discover any gaps or gains. This is further strengthened by the nationwide acceptance, training, and use of the Department of Homeland Security, Homeland Security Exercise and Evaluation Program (HSEEP) which provides a nationwide framework for exercises and improvement.
- Numerous tools have been created to help water and wastewater utilities be better prepared for crises and emergencies. These include:
 - Water Health and Economic Analysis Tool (WHEAT), that is a consequence analysis tool designed to assist drinking water and wastewater utility owners and operators in quantifying human health and economic consequences for a variety of scenarios that pose a significant risk to the water sector.
 - Vulnerability Self-Assessment Tool (VSAT), that is a risk assessment software tool for water, wastewater, and combined utilities to assist drinking water and wastewater owners and operators to conduct security threats and natural hazards risk assessment as well as updating utility Emergency Response Plans.
 - FedFUNDS, that is a new interactive Web site created to help water and wastewater utilities navigate through the maze of Federal Disaster Funding. See <http://water.epa.gov/infrastructure/watersecurity/funding/fedfunds/index.cfm>.

Existing and Emerging Contaminants

New contaminants in drinking water are often discovered and then regulated because of increased pollution, improved analytical abilities, and/or a better understanding of health effects. Media attention to a particular contaminant has also resulted in a legislative response to address or speed up the regulatory process. Examples include hexavalent chromium, pharmaceuticals, and personal care products. In addition, the health effects of many known contaminants are re-evaluated and re-regulated as new information becomes available. For many emerging contaminants, such as pharmaceuticals and personal care products, there may not yet be a full understanding of the health risks they cause in drinking water and available treatment technologies to remove them from drinking water. For such contaminants, the

pollution prevention and matching water quality to water use resource management strategies will help address water quality concerns while additional information is gathered. For pharmaceuticals and personal care products control of discharge to the environment is the best initial approach, via source control programs and reduction through wastewater treatment, rather than relying on drinking water treatment.

Emerging contaminants may be created by treatment itself, for instance, when water utilities implement new methods or processes for disinfecting water that may create new disinfection byproducts. For some contaminants, treatment options may be available, but they may be relatively expensive.

Recommendations

Because of the importance of drinking water, there is strong interest from many groups to promote improvements to drinking water treatment and distribution facilities, operation, and management. These groups include:

- Water system managers and operators.
- Local governmental agencies—city, county, planning.
- Regulatory agencies such as CDPH, local primacy agencies (county-level), and the U.S. EPA.
- Environmental and community stakeholders.

Based on the major issues outlined in this chapter, the following additional actions are needed to ensure there is adequate protection of public health through the maintenance of infrastructure, advancements in water treatment, and developing and maintaining relationships among the groups that advocate safe drinking water:

1. The Legislature should take necessary steps to maintain a sustainable source of funding of water supply, water treatment, and infrastructure projects to ensure a safe and reliable supply of drinking water for individuals and communities and to provide state matching funds for federal Safe Drinking Water State Revolving Fund monies.
2. Additional funding should be provided to CDPH to provide increased technical assistance to small water systems related to asset management and rate setting.
3. The Legislature should take steps to require publicly owned water systems to establish water rate structures at a level necessary to provide safe water, replace critical infrastructure, and repay financing for treatment and distribution system improvements necessary to meet drinking water standards.
4. State government should support enactment of a federal water infrastructure trust fund act that would provide a reliable source of federal assistance to construct and repair water treatment plants.
5. Additional programs should be developed to encourage regionalization and consolidation of public water systems. Regionalization and consolidation are useful both in achieving compliance with water quality standards and in providing an adequate economy of scale for operating and maintaining existing facilities as well as planning for future needs.
6. State government should continue to develop funding for small water systems and disadvantaged communities to assist in complying with drinking water standards.
7. State government should continue to encourage conservation and develop additional incentives, such as expanded rebate programs, to allow water systems to reduce the waste of limited water resources.

8. Public water systems that provide flat rate water service should strongly consider changing to a metered water rate structure to discourage waste. In addition, water systems that have water meters for some customers but not on all service connections should strongly consider providing water meters for all customers.
9. State government should consider providing incentives that would encourage water systems to adopt rate structures that encourage conservation and discourage the waste of water.
10. The Legislature should establish a requirement for all public water systems, whether in urban or other areas of the state, to install a meter on each service connection and charge a metered rate for actual volume of water used.
11. California's regulatory agencies, such as the State Water Resources Control Board and California Department of Public Health, should maintain internship programs for college students to continue the interest of the next generation in water and environmental regulatory agencies.
12. State government should support research and development of new and innovative treatment technologies by providing funding for demonstration pilot projects. Additional program funding is also needed by CDPH to address the review and acceptance of these new treatment technologies adequately .
13. Water systems should fully evaluate residual disposal issues when planning new water treatment facilities due to increased costs and other issues associated with disposing treatment residual wastes.
14. All public water systems should be encouraged to join the California Water/Wastewater Agency Response Network. This program will provide mutual aid and assistance more quickly than the normal resource requests submitted through the Standardized Emergency Management System.
15. The control of pharmaceuticals and personal care products in the environment should be addressed initially via source control programs and reduction through wastewater treatment.

Drinking Water Treatment and Distribution in the Water Plan

[This is a new heading for Update 2013. If necessary, this section will discuss the ways the resource management strategy is treated in this chapter, in the regional reports and in the sustainability indicators. If the three mentions aren't consistent, the reason for the conflict will be discussed (i.e., the regional reports are emphasizing a different aspect of the strategy). If the three mentions are consistent with each other (or if the strategy isn't discussed in the rest of Update 2013), there is no need for this section to appear.]

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Table 15-1 Public Water Systems in California by Class

Public Water System Classification	Number
Community	2,973
Nontransient noncommunity	1,490
Transient noncommunity	3,111
Total number of public water systems	7,574

Source: California Dept. of Public Health records, August 2012. Does not include water systems serving Native American Tribes or on tribal lands.

Table 15-2 Number and Type of CPUC-Regulated Water Agencies

CPUC class	Number of Connections Served	Number of Agencies in Class
A	>10,000	10 ^a
B	2,000-10,000	6 ^a
C	500-2,000	22
D	<500	85

Source: California Public Utilities Commission web site, June 2012.

^a Many of the private agencies included in the number shown operate multiple water systems throughout California

Table 15-3 Treatment Plants on California Public Water System Sources

Type of Contaminant	Approximate Number of Major Treatment Plants
Surface water ^a	699
Nitrate	150 ^b
Arsenic	79 ^b
Perchlorate	40
Radiological	10 ^b
Volatile and synthetic organic chemicals	220 ^b
Aesthetic water quality	350

Source: These estimates are based on a survey of California Dept. of Public Health offices and from California Dept. of Public Health records.

^a Surface water, defined under the California Surface Water Treatment Rule (Cal. Code Regs., tit. 22, § 64651.83.) means “all water open to the atmosphere and subject to surface runoff...” and hence would include all lakes, rivers, streams, and other water bodies. Surface water includes all groundwater sources that are deemed to be under the influence of surface water (i.e., springs, shallow wells, wells close to rivers), which must comply with the same level of treatment as surface water.

^b Includes only chemical removal treatment facilities. Blending facilities are not included.

Table 15-4 Metropolitan Water District of Southern California Treated Water Rate History

Year	Cost of Treated Water (\$/af)	
Historical and Current Water Rates		
1994	412	
1995-1996	426	
1997-2002	431	
	Tier 1 ^a	Tier 2 ^b
2003	408	489
2004	418	499
2005	443	524
2006	453	549
2007	478	574
2008	508	606
2009	579	695
2010	701	811
2011	744	869
2012	794	920
Projected Future Water Rates		
2013	847	997
2014	890	1032

Source: Metropolitan Water District of Southern California 2012.

^a Tier 1 supply rate – recovers the cost of maintaining a reliable amount of supply.

^b Tier 2 supply rate – set at Metropolitan Water District cost of developing additional supply and to encourage efficient use of local resources.

Table 15-5 California Department of Public Health Summary of Funded and Unfunded Projects

Funding Source	Funded Projects		Unfunded Projects
	Number of Systems	Funded Amount (million \$)	Unfunded Need (million \$)
SDWSRF	224	1,351	^a 11,700
ARRA	51	150	
Proposition 50	78	295	366
Proposition 84	88	81	174
TOTAL	441	1,877	12,240

Source: California Department of Public Health 2012.

^a ARRA used the SDWSRF project priority list for funding.

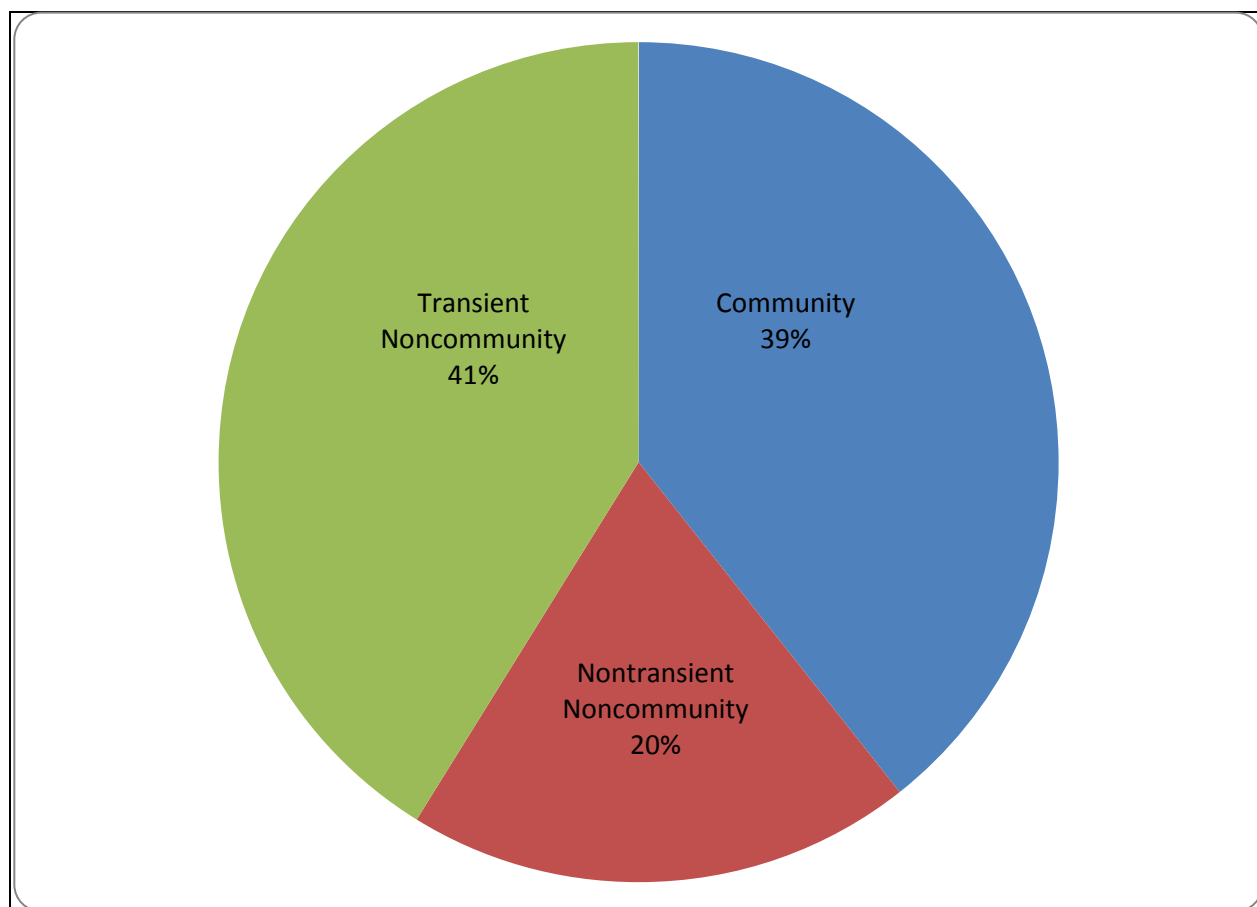
Table 15-6 California Safe Drinking Water State Revolving Fund: Capitalization Grants from the U.S. EPA

Fiscal Year	DWSRF Grant (million \$)	% of National DWSRF Funds
1997	75.68	—
1998	77.11	10.83%
		(FY1998-2001)
1999	80.82	—
2000	83.99	—
2001	84.34	—
2002	82.46	10.24%
		(FY2002-2005)
2003	81.97	—
2004	85.03	—
2005	84.85	—
2006	67.10	8.15%
		(FY2006-2009)
2007	67.10	—
2008	66.4	—
2009 SDWSRF	66.4	8.15%
2009 ARRA ^a	159.0	8.15%
2010	137.32	9.35%
		(FY2010-2013)

Source: U.S. EPA Drinking Water Needs Survey 2009 and the Federal Register. See link for more information on DWSRF state allotments: (http://water.epa.gov/grants_funding/dwsrf/allotments/).

^a In 2009, California Department of Public Health also received funding under the American Recovery and Reinvestment Act (ARRA) that essentially followed Safe Drinking Water State Revolving Fund (SDWSRF) funding rules.

Figure 15-1 Public Water System Class by Percent of Systems



Box 15-1 Rosamond Community Services District Regional Consolidation Project

The Rosamond Community Services District (CSD) Regional Consolidation Project is currently in the feasibility and planning stage to solve water quality problems of nine small water systems (one high school, four mutual water companies, one apartment complex, and three mobile home parks) in the Rosamond area. Eight systems have arsenic MCL violations and one system has a uranium MCL violation. Funding for this regional consolidation project will be through a combination of SDWSRF and Proposition 84 funding.

The ultimate plan will physically consolidate eight water systems with Rosamond CSD by using a combination of pipelines, storage tanks, and booster pumps. By consolidating the small water systems with Rosamond CSD, the customers of these small systems will receive water that meets drinking water quality standards and avoid installing treatment equipment which is very expensive to operate and maintain and may be unaffordable.

One mutual water company, which is farther away from Rosamond CSD and is currently under a court-ordered receivership with Rosamond CSD being the court appointed receiver, may need to install arsenic removal treatment equipment depending upon its affordability. This project will explore managerial consolidation of this mutual water company with the Rosamond CSD, in an effort to improve the economy of scale for this project and to improve operational reliability of any treatment installed.

It is anticipated that Rosamond CSD will request construction funding for the project following completion of the feasibility and planning studies.

Box 15-2 City of Glendale Chromium-6 Treatment Residuals Disposal Study

The City of Glendale completed a study comparing the treatment residuals waste produced by two treatment processes for removing chromium-6: a weak-based anion exchange (WBA) process and a reduction/coagulation process that removes chromium-6 through filtration (RCF).

The main waste in the WBA treatment process is spent ion exchange resin. Based on results of the federal Toxicity Characterization Leaching Procedure (TCLP) and the California Waste Extraction Test (WET), the waste resin is classified as a California-regulated non-RCRA waste and requires special handling and disposal. Additional waste characterization is needed due to the detectable quantities of uranium and thorium in Glendale's source water. While these contaminants are in the source water at concentrations below the maximum contamination levels (MCL), they are removed in the treatment process and concentrated in the resin. Testing was also conducted to determine whether the waste resin would be classified as a Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) or a Low-level Radioactive Waste (LLRW). Findings indicated that waste resin would not be classified as TENORM as long as the waste resin could be taken out of service prior to reaching uranium concentrations of 0.05% by weight, where it would require even more expensive disposal and handling as a LLRW.

The wastes from the RCF process are mostly settled solids after thickening and dewatering. The solids from the RCF process are classified as California-regulated non-RCRA waste and they are not classified as either a TENORM or a LLRW since the RCF process does not remove or concentrate appreciable quantities of uranium.

The disposal of treatment waste streams in California adds a major cost component to the cost of treating drinking water. Rather than disposal at a local landfill or other approved land disposal option, spent resin or solids must receive special handling and be sent to special disposal facilities that accept hazardous and/or radioactive materials.

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Boxes

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Chapter 30. Water and Culture

Water has a special place in all human societies. It's the essence of fertility and growth, of sustained life, associated with cleansing and renewal, with the spiritual forces of the cosmos. We've worshipped it and celebrated its magical, flowing qualities, commemorated its mystical dimensions...it has an indispensable role in human life, for it lies behind everything we do...Water is one of the few cultural universals, inspiring a profound mingling of ritual and day-to-day use.

Elixir: A History of Water and Humankind

While water is one of the few cultural universals globally, there is great diversity about how water is perceived, valued, used, distributed, and regulated in California. There are many understandings of water and different meanings of water that reach beyond the conventional standpoints of use and commodification in water management and supply distribution.

Water and culture are connected in a myriad of ways, with subtle and complex implications for water management in California. Some cultural relationships to water are so pervasive, they may be easy to overlook. Other cultural considerations are less apparent and may be difficult to recognize. Increasing the awareness of how cultural values, uses, and practices are affected by water management, and how these have an effect on water management as well, such information will help inform policies and decisions. Even regulations reflect cultural values by their practice such as water, when viewed as a commodity, may be controlled through laws, regulations, and policies. See Box 30-1 for the types of California laws and policies about cultural resources.

PLACEHOLDER Box 30-1 Laws and Policies

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

Water resources have shaped the history of California, contributing to the current social, cultural, and economic patterns across the state. The presence of freshwater sources has influenced the location of settlements and communities for hundreds, even thousands, of years. Water resources have also been pivotal to key economic activities such as fishing, mining, agriculture, manufacturing, as well as tourism and recreation. These historic aspects of development continue to have ramifications for water managers today.

Water and water-dependent resources also shape individual and collective experiences contributing to individual and community well-being, sense of identity, and connection with the natural world. These experiences are inextricably linked to values, traditions, and lifestyles, which in turn inform perspectives and expectations regarding water resources and conditions. More important, cultural considerations are inherently linked to every resource management strategy.

What is Culture?

All of us have some notion, or have heard the word “culture,” but what is culture? Culture is a concept. The *Merriam Webster Dictionary* defines culture as:

The integrated pattern of human knowledge, belief, and behavior that depends upon the capacity for learning and transmitting knowledge to succeeding generations; the customary beliefs, social forms, and material traits of a racial, religious, or social group; *also*: the characteristic features of everyday existence (as diversions or a way of life) shared by people in a place or time; the set of shared attitudes, values, goals, and practices that characterizes an institution or organization.

Culture represents the larger collective lifeways, mindsets, and practices that represent the diversity of California’s social fabric. Shared passions, beliefs, histories, and experiences bring people together to create group and community identities. Many California tribes have their own creation story that may include water — tides, water spirit, ocean, rivers, springs, lakes, rain, creatures of the water, mud duck, convergence of water ways — forks, and the head waters. (Donna Miranda-Begay). Fishing towns and villages share social and cultural identities that derive from livelihoods that define ways of life. Ranching and agricultural communities were settled near water sources. These working landscapes provided habitat and vistas that characterized the West. The surfing and beach culture of California is directly associated with coastal and ocean resources, projecting an iconic image and serving as a key economic driver for the state. The environmental movement has advocated for coastal and river protections throughout the state.

For example, Box 30-2 indicates a range of diversity in how anthropologists and others may describe and define culture.

PLACEHOLDER Box 30-2 Diverse Definitions of Culture

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

National Park Service's Definition of Culture

The *National Register Bulletin 38* refers to its internal cultural resources management guidelines for its definition and view of culture:

Culture [is] a system of behaviors, values, ideologies, and social arrangements. These features, in addition to tools and expressive elements such as graphic arts, help humans interpret their universe as well as deal with features of their environments, natural and social. Culture is learned, transmitted in a social context, and modifiable. Synonyms for culture include lifeways, customs, traditions, social practices, and folkways. The terms folk culture and folk life might be used to describe aspects of the system that are unwritten, learned without formal instruction, and deal with expressive elements such as dance, song, music and graphic arts as well as storytelling.

National Register Bulletin 38: Guidelines for Evaluating and Documenting Traditional Cultural Properties, Appendix I

The opposite of maintaining an open and respectful view about different cultures is called ethnocentrism, described as “evaluating other cultures from the perspective of one’s own presumably superior culture” (Bodley 1997) and being unable to “sympathize with the feelings, attitudes, and beliefs of someone who is a member of a different culture” (Parker and King 1998).

Cultural Resources and Cultural Resources Management

Cultural resources are comprised of both physical and intangible aspects of social practices, routines, and ways of life. Intangible aspects of culture include language, beliefs, practices, and traditions. These are often associated with cultural resources comprised of physical objects or places including structures, cultural landscapes (which combine natural and constructed elements), specific locations with special significance, or natural materials.

Management choices for some cultural elements are guided by statutory requirements. For example, cultural resources representing historic artifacts, sites, and buildings may be protected under the National Historic Preservation Act. The equitable distribution of effects and benefits is evaluated with regard to environmental justice and public trust factors. Other cultural materials, uses, and practices might need to be assessed within the context of a particular policy or project.

Native Perspectives of Cultural Resources and Cultural Resources Management

A cultural resource is the terminology and concepts applied to resources that are utilized by native tribal people for utilitarian and subsistence purposes in their traditional way of life (Goode 2011).

In Lakota culture, the saying is “We are all related.” Unlike Western views of management where humans manage their resources, tribes see humans as a part of the land, water, and air. On the first day of the 2013 Tribal Water Summit, some of the highlighted themes were

- The need for collaborative resource management.
- The value of oral, historical, and qualitative data applied to good resource management.
- Cultural identity is tied to the land and natural resources.
- Sharing tribal ecological knowledge requires trust and relationship building (Paula Britton).

Cultural prosperity for tribes is dependent on caring for the natural world. Re-creating past conditions requires an understanding of how people lived in their environments. For example, selective harvesting or culling was informed by traditional knowledge. Similarly, cultural burns involved fire mosaics that were timed and managed to generate specific types and qualities of resources. Other practices, such as rock drop structures, enhanced groundwater recharge, stabilized stream flows, and created riparian habitat. The managed environment provided food, medicine, and building materials for the tribe. Removing people from the landscape is neither healthy nor sustainable. For centuries, tribes have experience in observing, evaluating, and manipulating ecosystems to continue their way of life and preserve their traditions. Tribes want to manage their lands and watersheds, and at the very least to co-manage them. Tribes are willing to work with local, State, and federal agencies to achieve this (Nathan Voegeli).

A further example of this is the Marine Life Protection Act (MLPA) process. The MLPA Initiative was presented as a case study at the 2013 Tribal Water Summit. When it was first developed, the MLPA

addressed only commercial and recreational uses of marine resources. Tribal involvement was very limited. As the process evolved, there were geographically sequenced meetings along the California coast, moving from Southern California to Northern California. Tribes were disenfranchised in the earlier sessions and shared information with North Coast Tribes. When the process reached the North Coast area, it was apparent that tribes expected to be involved and that they had support from local government, fishing, and environmental interests.

There were challenges and frustration regarding MLPA and how it was developed. With time, the initial confrontations turned into a commitment to change the outcome. The process was not perfect and some tribal desires did not move forward. However, the process did change the paradigm of how tribes and State agencies work together and how policies can be influenced to support tribal sovereignty and improve the management of natural resources.

The MLPA process was one example of the valuable information tribes possessed, also known as Tribal Ecological Knowledge (TEK), that can inform agency practices in a number of ways. Formally, government-to-government consultation can guide policies and practices. Tribal practitioners can provide input on specific plans or proposals informally. Western science and TEK are both science-driven. Both are essential to better managing fishery, forest, and watershed resources. Agencies and tribes have a shared interest in working together on resource management and restoration activities.

For example, North Coast tribes worked with the Regional Water Quality Control Board to develop a new beneficial use category to protect cultural practices. Tribes throughout the state are working with the State Water Resources Control Board to have all regional basin plans have a cultural use category. The State Water Resources Control Board is also considering adding a beneficial use for subsistence fishing (Felicia Marcus).

Cultural Considerations and Water Management in California

Expression of cultural connections to water and water-dependent resources can involve a wide range of activities and material objects. The following categories of cultural activities are offered to encourage reflection and discussion on the different ways that water and culture interface. The categories are for illustrative purposes only and contain areas of overlap. Examples of water management factors are provided in each section. Also, any social, cultural, or economic uses of waterways or water-dependent resources can impact the resource base. This can result from trash, overuse, or the introduction of non-native species.

Subsistence Activities include traditional hunting, fishing, and collecting plants for food sources, medicinal properties, and raw materials. Water flows and water quality are critical aspects of supporting water-dependent subsistence activities. Public health risks can occur if food sources are obtained from contaminated water bodies. These risks are increased with higher consumption levels of locally obtained food sources that can occur in subsistence households and communities. This can well exceed safe consumption levels. For example, no more than three servings a week of fish caught in a particular lake or stream should be eaten due to a health risk in that particular lake or stream. Also, communication relating to risks or contamination may be hampered by language barriers.

Recreation Activities embrace a broad spectrum of pursuits that range from full-body contact (swimming, surfing) to minimal contact (water providing the scenic backdrop for hiking and wildlife viewing). Recreational pursuits encompass motorized and non-motorized activities. These activities range, for example from boating and riding jet skis to picnics and kayaking. Here again, water flows and water quality are key factors contributing to recreational experiences. Public health risks can occur if waters are contaminated. Beach closures, which protect public health, also affect recreation and tourism. Another factor that can influence water-related recreation is the availability of facilities, such as boat ramps, parking, rest rooms and general-purpose stores.

Spiritual Activities draw upon the cleansing, healing, and renewing properties of water. Examples include outdoor baptisms, sweat lodges, lakeside weddings, Native American ceremonies, and the blessing of the fleet in fishing communities. While these examples focus on particular activities, some perspectives see an inherent spirituality in water itself, which is always present. These events and perspectives share a common theme in transcending the mundane through a sacred and profound connection to water. In addition to water levels/flows and water quality, those seeking a spiritual experience may include considerations of aesthetics and solitude. A busy pattern of recreational use on public lands could interfere with sacred pursuits.

Historic Preservation seeks to maintain the legacy of the past by protecting historical features (artifacts, sites, places, buildings, or cultural landscapes). Some historic objects may be directly related to water infrastructure (diversions, flumes, mills). Other historic features may not be directly related to water resources, but are challenged by water management projects and activities. For example, receding waterlines at lakes or reservoirs could expose protected historic features. Conversely, surface storage facilities could inundate historically or culturally significant features or locations that are important to a community. Another example is water system upgrades that need to modify or replace historic infrastructure or support buildings, or new water projects where ground-disturbing activities could destroy historic resources. Water managers are encouraged to review the legal requirements with their legal office that might be associated with these situations. A list of key statutory provisions is provided in another section of this resource management strategy.

Lifeways represent the larger collective mindsets and practices that represent the diversity of California's social fabric. Shared passions, beliefs, histories, and experiences bring people together to create group and community identities. Several of the lifeways, which have come to typify California to the rest of the world, have a strong connection to water.

- Native American tribes often describe their social and cultural identities in terms of being inseparable from the natural world.
- Fishing towns and villages share social and cultural identities that derive from livelihoods that also define ways of life.
- Ranching and agricultural communities were settled near water sources; these working landscapes also provide habitat and vistas that characterize the West.
- The surfing and beach culture of California is directly associated with coastal and ocean resources, projecting an iconic image and serving as a key economic driver.
- The environmental movement in California has strongly advocated for coastal and riverine protections throughout the state.

These lifeways are characterized by a close relationship with the land and waters. The well-being of the environment and the community are one, with responsibilities to long-term stewardship and heightened awareness, knowledge, and expertise regarding local conditions.


California Native American Tribes' Relationships with Water

All plant and animal resources are water dependent. Resources have a variety of water dependent levels. Village sites and areas for cultural practices are found within a quarter mile of water whether it is a spring, creek, river, etc. which may still exist or once existed. It is no surprise that any excavation near a water body uncovers artifacts, such as bedrock mortars, petroglyphs, and tools, prove that Native American life was dependent on water. Therefore, their traditional practice of taking care of the land was highly relevant to keeping the water restored so that their resources had a continuum of regeneration (Goode 2011).

Below are excerpts from the 2013 Tribal Water Summit speakers sharing their tribe's relationship to water and the importance of managing the watershed for improved water quality and quantity:

- TEK has been passed down over thousands of years through oral traditions. Historic and ethnographic efforts continue to document this knowledge. It is time to incorporate tribal knowledge into restoration efforts led by local, State, and federal agencies.
- Tribes are a product of their homelands and ceremonies are tied to the land. The practices and conditions associated with caring for the land are transmitted orally down through the generations as TEK (Ron Goode).
- Materials used to weave a basket come from clean water and proper management of that resource (Don Hankins).
- When I hand someone a piece of willow, sedge, or bear grass I ask, "How clean was the water that this grew in?" Because they are now affected by it (Ruthie Maloney).
- Basket weavers split materials with their teeth. Important to avoid sprayed vegetation. Older weavers gather by road due to mobility constraints. Road vegetation gets sprayed (Sage LaPena).
- Not all tribes able to practice because of land constraints, lack of access, lack of protection, and preservation issues, but they continue their cultural knowledge to teach and practice (Lois Bohna).

Below are examples of how lack of access to water or unmanaged water diversions has affected Native American life.

- With no flows in the Trinity River, the Hoopa Valley Tribe cannot practice their river dances e.g., Flower Dance, Boat Dance, Deerskin Dance, and Jump Dance.
- Because a spring ran dry due to drought and groundwater pumping in Nevada, the Susanville Indian Rancheria could not perform their purification sweats to reconnect with Mother Earth. The Bureau of Land Management trucks in water so that ceremonies can continue (Aaron Dixon).
-  ~~LADPW diversions have dried Owens Lake and reduced Mono Lake water levels (Donna Vasquez and Alan Bacoek).~~
- Water from the San Jacinto Mountains is diverted for residential areas causing low flows and preventing the hot springs to recharge. Hot springs are used for cultural practices. Low flows also inhibit subsistence activities or recreational contact. Without water, plants used for baskets, medicine, and events cannot grow. The culture dies (Erica Helms-Schenk).

- If Native Americans are not allowed to access their native sources, ancestral, or sacred sites, how can the culture continue and thrive? How will the traditional knowledge of the elders be passed down to the youth? The 2013 Tribal Water Summit echoed repeatedly how Native Americans hope to manage their lands and are open to co-managing with partner agencies and organizations. Many examples of successful co-management have been shared as well as examples of tribes acquiring land to manage for their own.

Everything in the natural world comes from the same place. Human beings are not separate from the other forms of spirit people (Leaf Hillman).

Photo Examples

Ceremonies - Mati

Traditional resource management practices: burning, stewardship activities, - Ron

Subsistence activities: root/reed collection, - Lois

Implications for Water Management

Understanding the activities and accomplishments of past groups is important since the decisions made in the present are often influenced by the past. Simply stated, in order to understand the future, there first must be an understanding the common past and heritage shared by all. This is particularly relevant within California as the state's history is bound to the availability and development of water infrastructure. Without understanding the basis and context of existing infrastructure and management, it is difficult to understand the consequences of future actions.

In today's context, cultural practices and perspectives may also be a source of conflict or result in special management needs. For example, a number of immigrants bring cultural practices to California and continue them, which may result in unintended consequences. For example, subsistence fishing may expose a community to high levels of contaminants. In other cases, historic practices of long-time residents that were a high utility at one time may create or experience unintended consequences due to demands of competing uses or increased concerns over potential negative impacts. One example is the controversy over suction dredging. Still, other conflicts arise as the state becomes increasingly urban and loses some of its historic character.

Other current water management issues are directly tied to past economic and development patterns are:

- Placer mining legacy issues of heavy metals contamination.
- Reclamation of floodplains and wetlands and developing them.
- Hydropower operations and consequences for sediment management, fish passage, and water flows and temperature.
- A hybrid system of water rights which encompasses riparian and appropriate rights and adjudicated groundwater basins.
- Through the 20th Century, dairies were encouraged to locate on waterways to help manage waste, which has created a legacy issues.
- Logging activities and flash dams, which modified watersheds.

- Construction of large-scale water infrastructure systems, which have fundamentally changed many areas of the state.
- Railroad construction and the dewatering of high-elevation meadows.
- There is a new urgency in planning and protecting the shoreline for water-dependent uses. Many view the preservation of land for water-dependent uses, in part, as the preservation of the historical and cultural resources that contribute to the charm of coastal communities. Policy-makers have used restrictive zoning, tax abatement, public acquisition of critical parcels through fee-simple or less-than-fee purchases, and transfer of development rights to surrounding lands to conserve those lands best suited for water dependent uses (Goodwin, 1994). The public benefits are protected or required. The unique characteristics of waterfronts provide a wide array of public benefits involving the economy and jobs, the culture of the community, the physical environment, access to the waterfront, and many other dimensions. These public benefits provide local communities with both the rationale and the goals for developing programs to preserve and maintain water dependent uses.

Potential Benefits

1. Using traditional knowledge and practices to better sustain and integrate water management and provide models of sustainability.
2. Continuation of traditional practices and knowledge to future generations.
3. Improved recognition and support of cultural diversity and heritage resources.
4. Potential partners and alliances for projects, leveraging different funding sources.
5. Preserving everyone's understanding of California's history.
6. Understanding the historical context for community establishment, avoid repeating past problems, recognizing the challenges for sustainability, and the need for remediation.
7. Avoiding conflict and litigation.
8. Avoiding costs (remediation).
9. Understanding cultural implications associated with sea level rise, adaption, and mitigation responses.
10. Peace of mind, quality of life, life passages.
11. Serving as models of sustainability.
12. Learning more about natural processes (rivers/oceans are teachers).
13. Compliance with cultural resource management laws, requirements for State agencies to have inventory of historic assets and report them to Office of Historic Protection.
14. Understanding perspectives that influence water conservation, water management approaches.

Potential Costs

Costs associated with:

- Education and outreach.
- Restoration.
- Research.
- Mitigation.
- Retreat.
- Historic preservation involving taking inventory, evaluating structures for significance, and making management plans (e.g., cultural landscape management plans). Costs depend on scale.
- Interpretive exhibits, markers, plaques.

- Legal.
- Repatriation.

Major Implementation Issues

1. Lack of information and education of what laws apply and determine who is responsible.
2. Private land owners are not policed if cultural remains or artifacts are found on their property.
3. Concerns similar to those associated with habitat for endangered species (i.e., safe harbor) that protection or mitigation efforts may constrain future choices. Once there is a historic designation, it's hard to remove a building.
4. Inherent rights to access and use the waters of the state, tension between access and public property — bottom of the river vs. banks of the river (Article 10 of the California Constitution).
5. Coastal access triggers discussion of mean low- and high-tide levels.
6. Lack of information regarding whom to contact, procedures, and hiring cultural monitors and archaeologists. Lack of agency alignment regarding roles and responsibilities; issues may not be referred to other related programs.
7. Cultural distrust from past experiences makes it difficult to communicate about cultural considerations (e.g., introduction on non-native species, [contact DFW, Boating and Waterways; consumption of contaminated fish] – [check with SF Estuary Institute]; dependence on revenue from existing invasive species (e.g., striped bass).
8. Information on cultural and historical resources exists in various databases. Some of the information, such as regional Information Centers, is a fee-for-service basis.
9. Important water resources may originate in areas with little political clout.

Climate Change

Climate change is projected to have a significant impact on water and water-dependent resources in California. Increased air temperatures will result in warmer water temperatures, a shift in precipitation with more precipitation falling as rain rather than snow, more frequent and intense droughts, and rising sea levels. While future precipitation is somewhat uncertain, greater flood magnitudes are anticipated due to more frequent atmospheric river storm events (Dettinger 2011). In addition, changes in the type and timing of precipitation will result in altered surface runoff and volumes, with more runoff occurring in the winter and less in the spring and summer. These changes will affect the water-dependent resources that currently support many cultural activities.

Changes in temperature and precipitation will affect ecosystems throughout the state and impact the subsistence activities that these ecosystems support, especially those that rely on specific species of plants and animals that are particularly vulnerable to the projected changes. Changes in surface runoff and volume, greater salinity intrusion associated with sea level rise, and warmer water temperatures will also impact recreation and spiritual practices associated with water as water levels, stream flows, and water quality are reduced. Historic preservation activities will also be impacted with important cultural sites being at greater risk either due to exposure during extended drought periods or by inundation or physical damage during extreme flood events. More frequent and intense wildfires could also impact all of these cultural activities.

Adaptation

Probably the biggest impact to water-dependent culture resources will come from large-scale ecosystem changes. However, while climate change creates challenges for ecosystems, maintaining and creating healthy and resilient ecosystems can also reduce the impacts associated with the anticipated changes in temperature and hydrology. Certain actions, such as high-elevation meadow restoration, can slow down increased winter runoff allowing it to recharge underlying aquifers and then slowly releasing that water to help maintain summer in-stream flows. Floodplain restoration also provides similar benefits in protecting water resources while also providing critical habitat for numerous species. In coastal areas, wetlands can provide a buffer against rising sea levels while improving water quality and providing habitat for numerous species.

Mitigation

1. Provide outreach and financial and technical assistance to the extent feasible to protect culture resources and increase better understanding of a) carbon sequestration potential with watershed and riparian forests and b) water conservation and water use efficiency for climate change mitigation.
2. Mitigate, minimize, and reduce greenhouse gas emissions (GHG) related to the water project impacts on culture resources to the extent feasible.
3. Identify tribal opportunities for water recycling and renewable energy and promote understanding of cultural practices and implications associated with climate change mitigation and responses.
4. Provide benefits and incentives for tribal water and energy use efficiency projects.

Other Resource Management Strategies

- Chapter 3, “Urban Water Use Efficiency” describes attitudes about recycled water, water meters, lawns, desalination.
- Chapter 4, “Flood Management” discusses lifestyles and land use.
- Chapter 8, “Water Transfers” as timing of water deliveries from natural systems changes, the traditional approaches for water transfers has to be revisited.
- Chapter 17, “Matching Water Quality to Use” Use recognizes that not all water uses require the same quality water. Conflicts can occur when water designated as non-potable is accessible to the public, who are uninformed that water quality does not meet public health standards.
- Chapter 18, “Pollution Prevention” discusses proper land use management practices to prevent sediments and pollutants from entering the water body.
- Chapter 22, “Ecosystem Restoration: discusses differences of objectives between removal of human-made changes for environmental benefits.
- Chapter 31, “Water-Dependent Recreation” provides additional discussion on recreational aspect of culture and water.

The cultural context needs to be considered when implementing any resource management strategy. Every approach requires looking at the cultural context and any land use activity might require a cultural resource inventory.

Recommendations

1. Water management agencies should have an appointed preservation officer who is responsible for cultural resource stewardship, developing policies and plans for the protection of historical resources, and ensuring that the agency follows these policies as well as applicable State and federal requirements.
2. Water management agencies should have cultural resource management programs, which include the following:
 - A. Inventory of all cultural resources within the jurisdiction of the agency.
 - B. Program of systematic condition assessment of cultural resources.
 - C. Develop treatment plans and prioritized programs for routine maintenance of individual resources.
 - D. Establish and maintain a data file for each cultural resource or groups of resources organized by field division(s).
 - E. Identified research goals for archaeological, ethnographic, and historical research proposed within the jurisdiction.
 - F. Management of any archaeological or historical object collections maintained by the agency.
 - G. Establish and maintain relationships with California Native American tribes and communities who may have an interest in the cultural resources of the agency.
 - H. Staff training and education about cultural resource management.
 - I. Coordination with local archaeological and historical societies and other groups with an interest in cultural resource protection.
3. Educate the public about the Surfrider Foundation, the Bolsa Chica \$150 million settlement, *Cadillac Desert*, Mary Austin, Tahoe Blue, and Friends of the River.
4. Educate children how watersheds work, provide knowledge about how water works, about water flow, how water moves, impacts of using water resource, AmeriCorps projects throughout state, communities service water project engage, and NPS/PS projects. Add the hydrologic cycle to the California education standard. Every student should learn the hydrologic cycle from headwater to ocean and the impact and dependency the state has on water.
5. Expand inclusion and integration of traditional/indigenous practices and knowledge in resources management and planning processes and decisions.
6. Educate the public about resource stewardship activities associated with different groups and organizations.
7. Centralize information on cultural and historical resources into one database.
8. Protect sensitive sites from vandalism.

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Box 30-1 Laws and Policies

California

- California Environmental Quality Act (CEQA) — California Public Resources Code Section 21000 et seq.
- Native American Historical, Cultural and Sacred Sites — California Public Resources Code Sections 5079.60 et seq.
- Preservation of Significant Archaeological Resource Areas and Associated Artifacts — California Public Resources Code Sections 5079.60 et seq.
- Destruction of Archaeological Sites and Caves — California Penal Code Sections 622.5 – 623
- Investigation, Excavation and Preservation of Historic or Prehistoric Ruins — California Water Code Section 23
- Governor's Executive Order No. W-26-92 — Management of significant heritage resources under jurisdiction of state agencies
- Governor's Executive Order B-10-11 — Encourages Communication and Consultation with California Indian Tribes
- California Natural Resources Agency Tribal Consultation Policy

Federal

- National Historic Preservation Act (NHPA) — 16 U.S.C. Sections 470 et seq.
- National Environmental Policy Act (NEPA) — 42 U.S.C. Sections 4321 et seq.
- Archaeological Resources Protection Act (ARPA) — 16 U.S.C. Sections 470aa et seq.
- Archaeological and Historic Preservation Act (AHPA) — 16 U.S.C. Sections 469 et seq.
- Native American Graves Protection and Repatriation Act — 25 U.S.C. Sections 3001 et seq.
- American Indian Religious Freedom Act — 42 U.S.C. Section 1996
- National Park Service Bulletin 36 — Protecting Cultural Landscapes: Planning, Treatment and Management of Historic Landscapes
- (Federal) Executive Order 13175 — Consultation and Coordination with Indian Tribal Governments (2000)

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Box 30-2 Diverse Definitions of Culture

Topical	Consists of everything on a list of topics or categories such as social organization, religion, or economy.
Historical	Social heritage or tradition that is passed on to future generations.
Normative	Ideals, values, or rules for living.
Behavioral	Shared, learned human behavior; a way of life.
Functional	Way humans solve problems of adapting to the environment or living together.
Mental	Complex of ideas or learned habits that inhibit impulses and distinguishes people from animals.
Structural	Consists of patterned and interrelated ideas, symbols, or behaviors.
Symbolic	Based on arbitrarily assigned meanings that are shared by a society.

Source: Bodley JH. 1997. Cultural Anthropology: Tribes, States, and the Global System. 2nd edition. p. 9, as modified from Kroeber A. Kluckhohn C. 1952. Culture, A Critical Review of Concepts and Definitions. Cambridge (MA): Papers of the Peabody Museum of American Archaeology and Ethnology no. 1. Harvard University